MAXIMUM HISTORICAL EXTENT OF AQUATIC HABITATS

Curtis Kruer constructed a GIS layer showing the "maximum historical extent of aquatic habitats" within the project area using ArcView™ GIS software. The term aquatic is used rather than wetland and riparian because the final GIS layer created also includes areas covered by ponds, streams and rivers. For purposes of creating this layer, circa 1800 was chosen as the reference time. Prior to 1800, humans were present in the valley but there was no significant human settlement. A number of sources including local, state, and federal agencies; state, university, and private libraries and museums; and communication with knowledgeable local residents, were used. The final GIS layer created is shown on a map included as Attachment D.

Historical Mapping Methods

The results of the historical research were used in conjunction with photo interpretation of historical aerial photography, topographic maps, floodplain maps, hydric soils data, ground water level data, current (2001) maps of wetland and riparian habitats, field surveys, and best professional judgment to locate the boundaries of the maximum potential extent of aquatic habitats in the Gallatin Valley. The following resources were used:

1) National Hydrography Dataset from USGS (digital)
2) 1937 aerial photographs of the Gallatin Valley (fairly complete set)
3) 1959 aerial photographs of the railroad corridor between Bozeman and Manhattan
4) 1995 black and white DOQQs of the project area (large prints and digital files)
5) 1995 black and white DOQQ mosaic of project area (large print and digital file)
6) NRCS hydric soils digital data (extrapolated from digital soils maps)
7) FEMA floodplain maps (prints and digital files)
8) 2001 CIR imagery
9) 2001 inventoried wetlands layer
10) 2001 inventoried riparian/wetland mixed layer

On screen digitizing of the boundaries for the maximum historical extent layer was performed using the 2001 CIR imagery developed for the project as a base layer. Digitizing was typically accomplished at an on-screen scale of approximately 1:8,000 with a minimum mapping unit for the historical extent of roughly 5 acres. Reconstruction of the historic boundaries was performed using 1937 aerial photographs as the primary data source. Unfortunately considerable alteration of aquatic habitats had occurred by that time.

Selected historical photographs were scanned to create digital historic images. These historic images, along with other digital data (e.g. topography, hydric soils, ground water, floodplain) could be displayed side-by-side in ArcView™ to aid in mapping and photo interpretation. The 2001 wetlands and riparian/wetlands mixed layers created by the Gallatin Local Water Quality District were merged in GIS to create a master shapefile. This master shapefile was then expanded utilizing the other data sources. Obvious artificial wetland and riparian habitats (i.e. along irrigation ditches, downslope from large irrigation ditches, etc.) were deleted from the historical extent coverage, leaving only naturally occurring aquatic habitats.

The digital National Hydrography Dataset (NHD) was acquired from the Montana Natural Resource Conservation Service (NRCS). This dataset shows the spatial distribution of rivers, streams, ponds, and lakes. The NHD data was imported into ArcView™ GIS and converted to a shapefile. The NHD shapefile was then edited to remove any obvious manmade features, leaving only natural occurring water bodies. Wetland and riparian corridors may have existed along many of the intermittent streams in the foothills and mountains around the valley edge but were often too narrow to be mapped for this project with the available resources. These streams, therefore, appear as digitized lines in the GIS coverage. Many streams (or reaches of streams), especially in the valley floor, had been destroyed or relocated prior to the creation of the NHD and even using old imagery, their historic alignment could not be located for mapping.

A GIS dataset was also obtained from NRCS that contained areas of hydric soils with a classification based on the percent of hydric soils within the data layer. It was also edited to remove any features that appeared to be man-made, leaving only naturally occurring features. The hydric soils layer was then edited to show only areas where the hydric soils mapping units contained 50% or more hydric soils. The final edited NHD and hydric soils shapefiles were then merged with the master shapefile to create the final master shapefile. Once this master shapefile was constructed the other data, including old aerial photographs, FEMA floodplain maps, and the CIR base map imagery were used to review and edit the layer.

Analysis of the Maximum Historical Extent GIS Layer

The final layer showing the *maximum historical extent of aquatic habitats* is shown on Attachment D in light blue. The 2001 *wetlands* layer and 2001 *riparian/wetland mixed* layer are shown on top of the maximum historical extent layer to allow for comparison of historical and current conditions. Figure 18 shows an example of the *maximum historical extent of aquatic habitats* layer on the CIR base map, in the area of Gallatin Gateway. Gallatin Gateway is located in the south central portion of the project area, near the Gallatin River. Figure 19 shows this same area in CIR without the data layers, and as seen on 1937 aerial photographs.

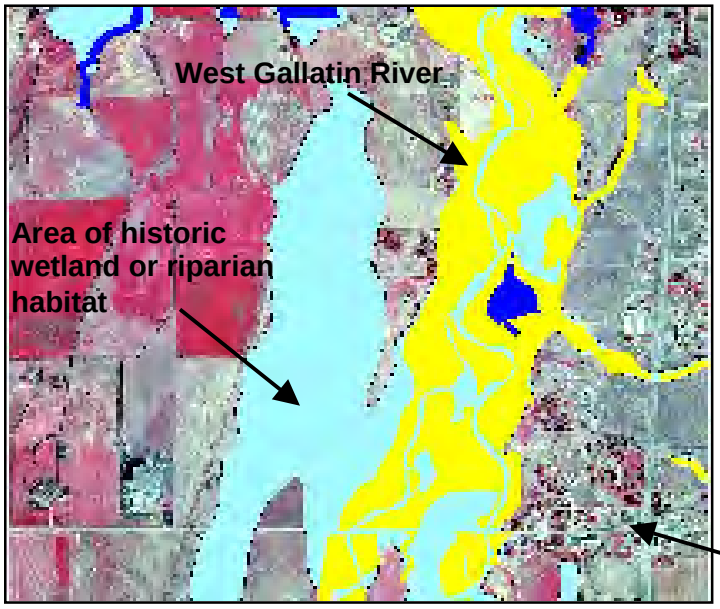

Figure 18. Example of GIS layer showing the *maximum historical extent of aquatic habitat* (light blue) with the 2001 *wetland* layer (dark blue) and 2001 *riparian/wetland mixed* layer (yellow) for comparison.

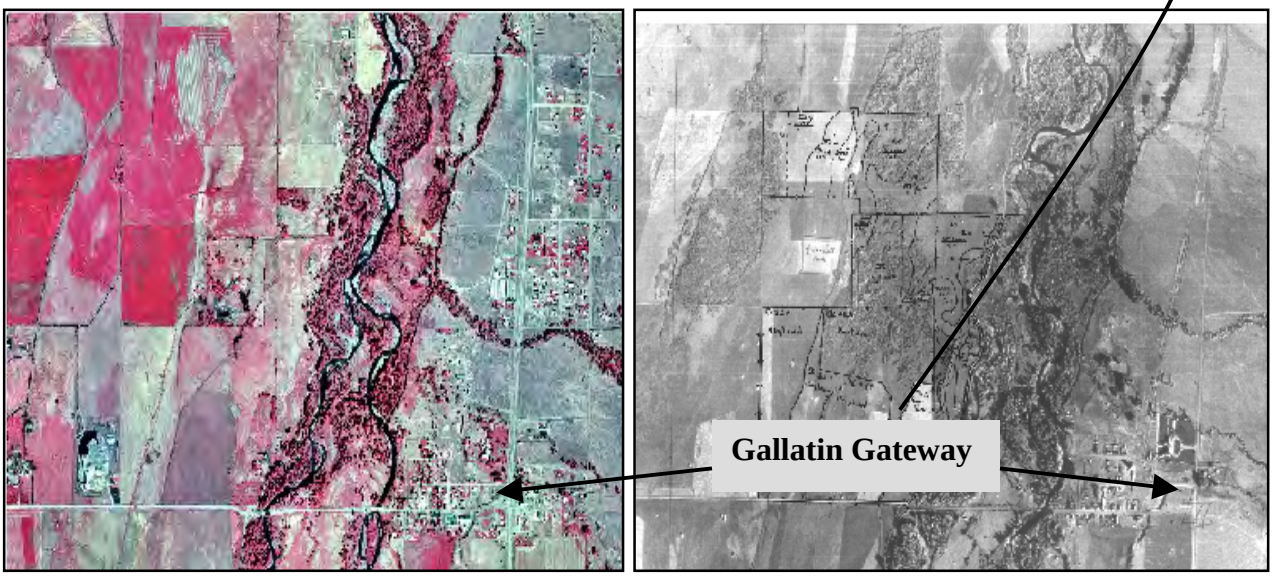

Figure 19. Comparison of Gallatin Gateway area as seen on CIR base map from 2001 and black and white aerial photograph from 1937.

The GIS software was used to calculate the difference in area between the maximum historical extent and the wetland and riparian areas mapped on the 2001 CIR imagery. The results are shown in Table 9.

Table 9
Area Comparison of Historical and Current Habitats

GIS Layer	Area (acres)	% of Project Area
Max. Historical Extent (circa 1800)	59,849	17.9
2001Total Wetland and Riparian Combined	22,904	6.9

The GIS comparison shows that prior to 1800 close to 60,000 acres of aquatic habitat may have been present in the Gallatin Valley. Based on the mapping of current conditions about 22,900 acres are currently covered by either wetland habitat or mixed riparian/wetland mixed habitat. If the maximum historical extent of aquatic habitats is compared directly to the areas mapped for 2001, the data suggests that only about 38% of the original habitat remains. This compares with a national average of 46% of historical wetland areas remaining. While there are errors and limitations associated with the GIS layers used for the comparison it provides a good overall assessment of the changes that have occurred.

Analysis of Focus Areas using Historical Aerial Photographs

To gain a better understanding of the changes that have occurred in wetland and riparian habitat in the Gallatin Valley, three focus areas were selected where good historic aerial photograph coverage was available. The focus areas were reviewed for examples of the changes over time due to drainage, irrigation, livestock, road and railroad construction, dredging and filling for development, removal of beavers, channel shifts, and the like.

Curtis Kruer created scanned images of selected black and white aerial photographs using the 1937 NRCS photographs and the 1959 railroad photographs obtained from the Museum of the Rockies. These scanned images were compared to the 2001 CIR imagery. Photo legends were overlain on the CIR imagery to show the areas covered by selected historic photographs. The black and white scanned images were not orthorectified, so spatial analysis of the changes could not be completed using ArcView™ GIS software.

The three focus areas selected were 1) the Gallatin Gateway area, 2) an area along the East Gallatin River, and 3) an area near Manhattan where Interstate 90 crosses the West Gallatin River. In the Gallatin Gateway area a significant decrease in riparian vegetation cover can be seen by comparing the 2001 CIR imagery with the 1937 black and white photograph (Figure 19). The most obvious changes appear west of the West Gallatin River and northwest of Gallatin Gateway. The visible changes correlate well with the maximum historical extent of aquatic habitats mapped by Curtis Kruer in this same area (see Figure 18). Due to the poor resolution of the 1937 photographs specific changes in wetland areas near Gallatin Gateway could not be documented. The changes that have occurred appear to be due to agricultural activity and suburban development.

Analysis of the area near the East Gallatin River along Swamp Road also shows a significant reduction in riparian and wetland habitat. Figure 20 shows a view along the East Gallatin as seen on the 2001 CIR and the 1937 black and white scanned image. Much of the change appears to be associated with clearing of riparian vegetation, but several drainage ditches also appear on the 2001 imagery, suggesting that historic wetland areas have been drained. The name Swamp Road also hints at the past condition of this area. Even today the area is very wet, but the amount of riparian and wetland habitat has been reduced.

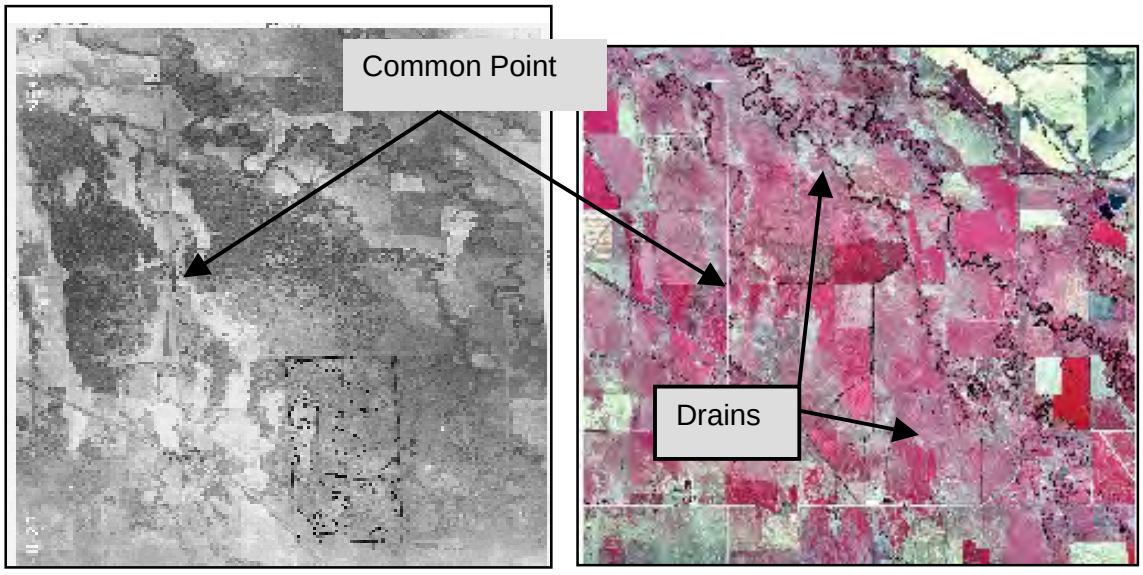

Figure 20. Comparison of 2001 CIR imagery and 1937 aerial photography near the East Gallatin River along Swamp Road (note that scales are not the same).

The final focus area analyzed, where Interstate 90 crosses the West Gallatin River, shows how construction of transportation corridors can impact riparian and wetland habitats. Figure 21 shows the 2001 CIR imagery and the scanned 1937 black and white imagery of the same area along Interstate 90. By 1937 the railroad bed had already been constructed. Surface water flow patterns appear altered from the south to the north of the railroad bed and has ponded along the south side of the railroad bed. During construction of the Interstate several gravel pits were excavated to the south of the Interstate. These gravel pits now form ponds that collect and concentrate surface water south of the Interstate. Both construction of the railroad bed and the Interstate appear to have resulted in a general drying of the land to the north of the Interstate and railroad. Several areas that appear wet on the 1937 image appear much dryer on the 2001 CIR image.

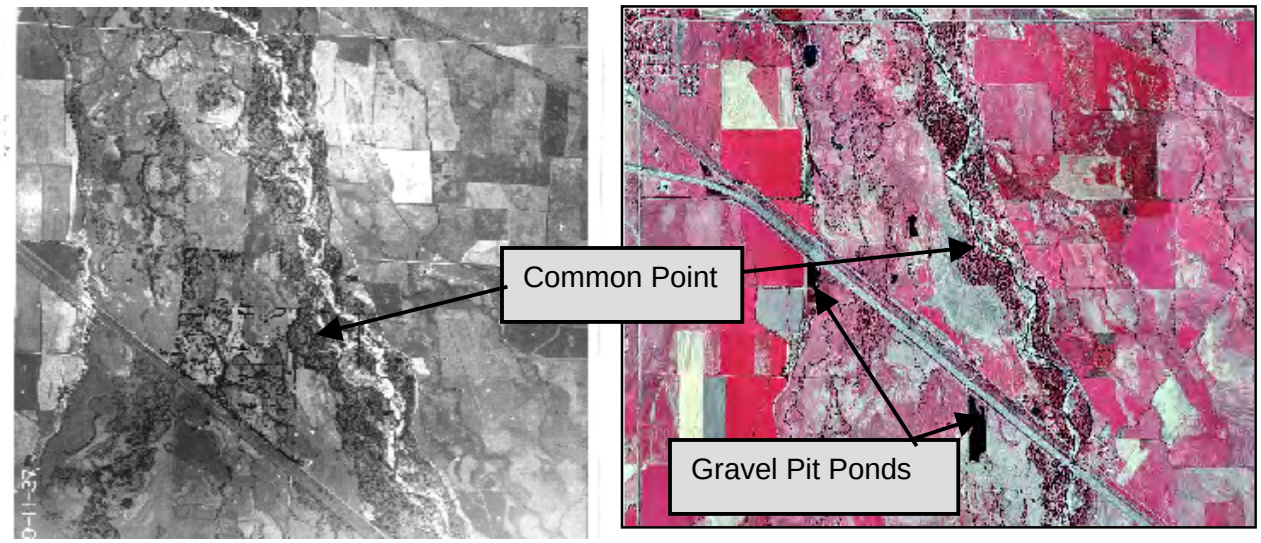

Figure 21. Comparison of 2001 CIR imagery and 1937 aerial photography near Manhattan, where Interstate 90 crosses the West Gallatin River (note that scales are not the same).